THE

SCIENTIFIC JOURNAL.

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On the Apparent Distance of Objects.

Dr. Potersfield gives a distinct and comprehensive view of the *natural* methods of judging of objects at a distance. The most universal means, says he, by which we compare distant objects, is the angle made by the optic axis. For our two eyes are like two different stations, by the assistance of which distances are taken; and this is the reason why those persons who are blind of one eye so frequently miss their mark in pouring liquor into a glass, snuffing a candle, and such other actions as require that the distance should be exactly distinguished. To convince ourselves of the usefulness of this method of judging of the distance of objects, he directs us to suspend a ring by a thread, so that its side may be towards us, and the hole in it to the right and left hand; and, taking a small rod, crooked at the end, retire from the ring two or three paces; and having with one hand covered one of our eyes, to endeavour with the other to pass the crooked end of the rod through the ring. This, he says, appears very easy, and yet, upon trial, perhaps once in one hundred times we shall not succeed, especially if we move the rod rather quickly. The doctor observes, that by persons recollecting the time when they began to be subject to such mistakes as above mentioned, they may tell when it was that

they lost the use of one of their eyes, which many persons are long ignorant of, and which may be a circumstance of some consequence to a surgeon. The use of this method of judging of distances, De Chales limits to 120 feet, beyond which, he says, we are not sensible of any difference in the angle of the optic axis. Another method of judging of distant objects consists in their apparent magnitudes, on which so much stress was laid by Dr. Smith. From this change in the magnitude of the image upon the retina, we easily judge of the distance of objects, as often as we are otherwise acquainted with the magnitudes of the objects themselves; but as often as we are ignorant of the real magnitudes of bodies, we can never, from their apparent magnitudes, form any correct judgment of their distances. From this we may see, why we are so frequently deceived in our *estimates* of distance, by any extraordinary magnitude of objects seen at the end of it; as in travelling towards a large city, or a castle, or church, or a more than ordinary large mountain; we find them to be further off than we fancied them to be. This also is the reason why animals, and all small objects, seen in valleys contiguous to large mountains, appear *very* small. For we think the mountain to be nearer to us than if it was smaller, and we should be surprised at the smallness of the neighbouring animals, if we thought them to be farther off. For the same reason, we think them very small when placed on the top of a mountain, or a large building, which appear nearer to us than they really are, on account of their very great size. Dr. Jurin accounts for our imagining objects, when seen from a high building, to be smaller than they are, and smaller than we fancy them to be when we view them at the same distance on level ground; it is, says he, because we have no distinct idea of distance in that direction, and, therefore, judge of the things by their pictures upon the eye only; but custom will enable us to judge rightly even in this case. Let a boy who has never been upon a high building, go to the top of the monument, and look

down into the street, the objects seen there, as men, and horses, will appear so small as greatly to surprise him. But ten to twenty years after, if in the mean time he has accustomed himself to look down from this and other great heights, he will no longer find the same objects to appear so small. And if he was to view the same objects, from such heights, as frequently as he sees them upon the same level with himself in the streets, the doctor supposes that they would appear to him just of the same magnitude from the top of the monument, as they do from a window one story high. For this reason, it is, that statues placed upon very high buildings, ought to be made of a larger size than those which are seen at a nearer distance; because all persons, except architects, are apt to imagine the height of such buildings to be much less than it really is. Another method is, the force with which their colour strikes our eyes. For if we are sure that two objects are of a similar colour, and that one appears more bright and lively than the other, we judge that the brighter object is the nearer of the two. Another method consists in the different appearance of the small parts of objects. When those parts appear distinct, we judge that the object is near; but, when they appear confused, or when they do not appear at all, we judge that the main object is at a great distance. For the image of any object, or part of an object, diminishes as the distance from it increases. The last method by which we judge of the distance of objects, is, that the eye does not represent to our mind one object alone, but at the same time all those that are placed between us and the principal object whose distance we are considering; and the more this distance is divided into separate and distinct parts, the greater it appears to be. For this reason, distances upon uneven surfaces appear less than upon a plane: for the inequalities of the surface, such as hills, and dales, and rivers, that lie low and out of sight, either do not appear at all, or hinder the parts between them from appearing, and so the whole apparent distance is diminish-

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ed by the parts that do not appear in it. This is the reason that the banks of a river appear contiguous to a distant eye, when the river is low and not seen.

PHILOSOPHUS.

Baltimore, May 10th, 1818.

Chemical Experiments.

Ex. 1. Pour a few drops of muriatic acid into a wine glass previously filled with the infusion of litmus, the blue colour will instantly be changed into a vivid red.

Ex. 2. Fill a small glass with the infusion of red cabbage; then pour a small quantity of liquid ammonia to it, the liquor will assume a beautiful blue colour, highty tinged with green.

Ex. 3. Pour a little sulphate of indigo into a wine glass containing water, then add about an equal quantity of liquid carbonate of potash; now if a piece of yellow cloth be dipped in the solution, it will come out green, a piece of white will come out blue, and a piece of red will become purple.

Ex. 4. Put some blue cabbage water into a wine glass, to which add an equal quantity of the sulphate of indigo; the two blue fluids, when mixed, will presently become red.

Gleanings.

Gazette. The word gazette is said by some to be derived from *gazera*, a *magpie*, or *chatterer;* by others from the name

of a little coin called *gazetta*, peculiar to the city of Venice, where newspapers were first printed, and which was the common price of those periodical publications; a third class of critics derive it from the Latin word *gaza*, colloquially lengthened into the diminutive *gazetta*, and, as applied to a newspaper, signifying a *little treasury of news*. See Curiosities of Literature, vol. 1. p. 271.

Circulating Libraries. These were first instituted in the eighteenth century. The first establishment of this kind, in London, was commenced by one Wright, a bookseller, about the year 1740. In 1800, the number of these libraries exceeded one thousand.

Doctor. The practice of conferring the honour of literary institutions on individuals of distinguished erudition, commenced in the twelfth century, when the Emperor Lotharius, having found, in Italy, a copy of the Roman civil law, ordained that it should be publicly expounded in the schools; and that he might give encouragement to the study, he further ordered that the public professors of this law should be dignified with the title of doctors. The first person created a doctor, after this ordinance, was Bulgarus Hugolinus, who was greatly distinguished for his learning and literary labours. Not long afterwards, the practice of creating doctors was borrowed from the lawyers by the divines, who, in their schools, publicly taught divinity, and conferred degrees on those who had made great proficiency in this science.

Pyramids. These buildings seem to have been contrived for places of refuge during inundations. The numerous, or lower classes of the people were naturally arranged on the side steps; the priests, the nobles, and the king, on the narrower summits of the structure, and thus each order of the people was secure, during the public danger, and in proportion to its rank, in the social pyramid.

Cards. It is not generally known that the Portuguese brought them from Hindoostan; that they were first an almanack of the fifty-two weeks, and were superstitiously consulted by the casters of nativity, about lucky days, and were at length really converted into instruments for influencing the fortunes of men.

Paper Making. The art of making paper from rags, is said to have been the invention of a Swiss, at Basil, in 1714; but Mr. Warton, in his "History of English Poetry," traces it to a much earlier period, I believe to the eleventh century, and there are specimens among the records, in the tower of London, which corroborate his opinion. They have, or at least had, grants, conveyances, and other deeds and evidences in England, written on paper that was as old as the conquest, and it is not improbable, but those quaternions of laws stiched together, whereof King Alfred, so long before, made his little *hand books*, were also of paper rather than of parchment, or vellum. John Tate, who is presumed to have lived about 1496, is said to have first made paper in England, or was at the expense of introducing the manufacture; for evidence is produced, that the English edition of Bartholomeus, printed by *Wynkin de Worde*, was the first book, for any thing we know to the contrary, that was printed upon paper made in England. John Spilman had a patent, from Elizabeth, for making paper. See *Fosbrooke's Gloucestershire.*

If the above gleanings prove suitable for the Scientific Journal, they will be followed by others, from

CURIOSUS.

Remarks on the Answer to the second Philosophical Question,

Mr. Editor,

In the second number of your journal, I observed the following question: "Why will not wax convey the electric fluid equally as well as iron?" When I first read this, I thought it one of those puzzles, which are frequently given to pupils at examination, and to which silence, on the plea of ignorance on the subject, is the most convincing proof of knowledge. Imagine my surprise, when I found, in No. 3, an explanation offered by one of your correspondents. I am still, however, of my old opinion; but that I may not be considered obstinate, or unreasonable, I will just state my objections to the theory of your correspondent. His first position is a *gratis dictum.*

There is no satisfactory evidence, that what are called good conductors of electricity, such as gold, silver, and copper, *are more dense* than the non-conductors, glass, resin, or wax; because the first are more ponderous than the others. The weight of a body, I know, has been considered by almost every writer as a proof of its density; but the least reflection will convince us that the one is not necessarily connected with the other. If I should assert that the particles of matter in a stick of sealing wax are as compact, or, in plain English, are as close as those in a piece of gold, or silver, how would your correspendent establish the point that they were not? Certainly not with a pair of scales. I shall, therefore, deny that the distance of the particles of matter from each other, evidently constitutes the difference between dense and light bodies; and as his whole theory is built on the assumption, that it does constitute the difference, it cannot be sufficient to account for the phenomena. But, *disputandis gratia,* I will admit that the electric fluid, like

caloric, possesses that most curious property of penetrating the most compact bodies, and of passing through them with greater facility than through those bodies, which, on account of their porocity, one would imagine would admit them more easily.—Pursuing this motion a little further,—your correspondent supposes that the capacity of bodies for conducting electricity increases exactly in proportion to their density. Suppose a rod of iron to be heated, the particles of matter which compose it are thus removed to a greater distance from each other. The rod is extended, and is less compact or solid. Now, if the above theory be correct, this heated rod would be a worse conductor of the electricity than it was before. But so far from this being the fact, its conducting power is increased. Indeed, we may add, that all conducting bodies expanded, or rendered less dense by heat, have that property in a greater degree. But what surprised me most was, that your correspondent asserted that a *vacuum* was a non-conductor of the electric fluid, when you know, Mr. Editor, that the most brilliant and interesting experiments in electricity are made by means of it; such as the "Aurora Borealis." A few experiments, indeed, seem to show, that the *Torricellian vacuum* is a non-conductor, but such an one cannot exist in the case before us. In answer to the ninth question, page 64. "Does dew rise or descend?" I reply, it does both. Experiment.—About the middle of the day, when the moisture of the earth is considerably evaporated, place a tub, or other close vessel, on the ground, with the mouth downwards. Early the next morning, if it be examined, both the inner and the outer side will be found wet.

Reply to Pliny's Letter to Lucinius.

Mr. *Allen*, page 82, has given a pretty satisfactory explanation of Pliny's intermitting fountain. I take the opportunity of stating, that intermitting springs have been discovered in this country. Among others are the following: one near the Black River, Jefferson county, New-York; one in Saratoga county, New-York, a description of which may be found in the third volume of the Transactions of the Society of Arts, in New-York; and Professor Ebeling, in his Geography of America, states that one exists near Hanover, in Morris' county, New-Jersey.

J. G.

Princeton, May 13th, 1819.

On Vegetable Instinct, and the Sleep and Sensation of Plants.

BY MR. TUPPER.

Instinct is a particular disposition, or tendency, in a living being, to embrace without deliberation or reflection the means of self-preservation, and to perform, on particular occasions, such other actions as are required by its economy, without having any perception for what end or purposes it acts, or any idea of the utility or advantages of its own operation.

Hence the difference between *instinct* and *volitions*, for we cannot reasonably refer to *volition* those particular actions for

which animals have occasion, and which they spontaneously perform, even before they can have experienced those sensations upon which the motive for action might be supposed to be founded. Of this class of actions is that of sucking; and it is very probable, that many other operations of animals, which seem to be the result of *volition*, are merely *instinctive*: otherwise we must, in many instances, ascribe them to a degree of intelligence and sagacity, even superior to that of the human species, at least in that which relates more immediately to their necessities and welfare.

An intelligent being has for the most part some motive in view for the performance of any particular operation; and he is thereby enabled to act in a way *similar* to others, or *differently* from them, according to the object he may *will* or *intend* to accomplish. His power of action is varied almost infinitely; but with respect to irrational beings it is different. Each of these is distinguished by a certain character, which not only denotes its species, but also in a great degree marks the nature of its abilities; and therefore, in comparing the attributes of the different orders of animals, we shall find, that whatever degree of intelligence may appear to be displayed by their actions, such actions always bear some relation to the particular organization of their frame. We cannot, therefore, make an animal perform any work of art, which is not related, more or less, to its natural habits; or, in other words, we cannot endue it with instincts which are foreign to its economy, unless we could at the same time new model the mechanism of its frame, and fit it accordingly for some new purposes.

The ingenuity displayed by the feathered tribe in the building of their nests, and the art and address exhibited by the spider in the weaving of its web, cannot fail to call forth the admiration of the observer. But the skill which these and many other animals exhibit, cannot be applied, even by the most sagacious of them, to purposes beyond the sphere of their parti-

cular wants. These wants are similar in every animal of the same species, and each exerts itself like the other for the purpose of providing for them, without the aid of instruction or experience. Hence, although we perceive that some particular purpose is intended by the performance of many of the actions of vegetables, as well as by those of animals, yet the intention is not in the agents themselves, but in that superintending Providence who has ordained their existence.

After these general observations, we are better prepared to consider some of those actions of vegetables which are founded upon their instinct; and a very familiar instance of motion in them, indicative of that attribute, is manifested by their universal aptitude to incline towards the light, which is so essentially necessary to their health and well being. This disposition is so great, that a plant will even twist its stem, and change the original direction of its branches and leaves in order to get towards it.*

Some naturalists however, ascribe these effects to the mechanical operation of light; but the evident benefit which a plant derives in consequence of those particular actions, as well as the circumstances attending these, render it most probable that they are the *spontaneous exertion* of that being to avoid what is prejudicial, and to obtain that which is more salutary to its nature; thereby, like animals, contributing to its own welfare and preservation.

If this *self inclination* of a plant towards the light were the effect of the mechanical action of that element, it is reasonable to suppose that a mechanical cause, operating on a plant so *powerfully* as to make it change the original direction of its branches

* It is also a remarkable and very curious fact, that even "plants in a hot house all present the fronts of the leaves to the light; and this influences even the posture of the branches to the side where there is most light, but neither to the quarter where there is most air admitted, nor to the flue in search of heat." *Vide* Smith's "Introduction to Botany."

and leaves, would necessarily act with more or less force: and as, moreover, that force is *continually* acting during the day, we should also be led to expect that, like other mechanical stimuli *frequently repeated*, or *long continued*, it would tend to exhaust, or at least to weaken, the living powers of a plant exposed to its influence, and that more particularly at a time when, from a state of debility, it is *less* capable of resisting the *exhausting* effects of exciting causes. But so far from occasioning any deleterious consequences, we find that *light* will very essentially contribute in bringing a plant from a weak and languid condition, to a state of health and vigour.

Climbing plants also afford a curious instance of instinctive economy. Some of these, having very slender stems, cannot, like most other plants, grow of themselves in a perpendicular direction; but, in order to compensate for this incapacity, nature has given them the power of moving or turning their branches and tendrils different ways, until they generally meet with a tree, or some other body, on which to climb or attach themselves, and when a tendril has laid hold of a support, it coils up and draws the stem after it.

Trees and other vegetables have likewise the power of directing their roots for procuring nourishment; and if this does not indicate an instinctive selection of food, it is at least something very analogous to it. For instance, a tree growing near a ditch, will be found to direct its roots straight downwards, on the side next the ditch, until they reach the ground below it, when they will throw off the fibres underneath, and ramify like the root on the other side of the tree. Some curious examples of this kind of instinct are related by Lord Kaimes, among which is the following: "A quantity of fine compost for flowers happened to be laid at the foot of a full grown elm, where it lay neglected three or four years; when moved in order to be carried off, a network of elm fibres spread through the whole heap; and no fibres had before appeared at the surface of the ground."

Many flowers also fold up their leaves on the approach of rain, or in cloudy weather, and unfold them again when cheered by the reanimating appearance of the sun. This is remarkably exemplified in the *Convulvulus arvensis*, *Anagallis arvensis*, and many others, but more particularly in the last, whence it has been called the poor man's weather-glass. In Watson's Chemical Essays, also, it is stated, that " *trefoil*, *wood-sorrel*, *mountain-ebony*, the *African marigold*,* and many others, are so regular in folding up their leaves before rainy weather, that these motions have been considered as a kind of instinct similar to that of ants."

To be Continued.

Solutions to Philosophical Questions.

Qu. 9.

Mr. *Baines.* Dew rises in the evening; it is the moisture of the earth converted into vapour by heat; but the coldness of the night condenses it, when it again *falls* to the earth. Mr. *M. Harrison.* In the day time the rays of the sun convert aqueous fluids into vapours, which the atmosphere holds in solution. The higher regions of the atmosphere contain less vapour than the strata nearer the earth's surface, and every stratum of air descends a little lower during the night than it was during the day, owing to the cooling and condensing of the stratum nearest the earth, which deprives vapour of its latent heat, and it becomes dew. Mr. *J. B——n.* M. Du Fay made the following

* This refers to the petals, not leaves, of *Calendula pluvialis.*

experiment, to ascertain the fact. He supposed if dew ascended, it must wet a body placed low down, sooner than one placed in a higher situation. To determine this, he placed two ladders against one another, meeting at their tops, and wider asunder at the bottom, and so tall as to reach 32 feet high. To the several steps of these he fastened large squares of glass, placing them in such a manner that they could not overshade each other. On the trial it appeared as Du Fay had conjectured; the lower surface of the lowest piece of glass was first wetted, then the upper surface, then the lower surface of the glass next above it, and so on, till all the pieces at the top were wetted. M. Muschenbrock, who embraced the contrary opinion, thought he had invalidated all Du Fay's proofs, by repeating his experiments with the same success, on a plane covered with sheet lead. But to this Du Fay replied, that there was no occasion to suppose that the vapour would rise through the lead, nor from the spot; but that as it arose from the adjoining open ground, the continual fluctuation of the air could not but spread it abroad, and convey it thither in its ascent. On the other hand, it has been said, that the reason why dew appears first on the lower parts of the bodies, may be, that in the evening, the lower part of the atmosphere is first cooled, and consequently most disposed to part with vapour. It does not, therefore, appear to be an easy matter to make experiments on this subject, such as to be perfectly decisive and satisfactory. Mr. *A. Hirt.* Dew is produced from the heat of the sun, in the following manner: During a summer day, the ground acquires a very considerable degree of heat, which causes wet grounds to give out their moisture, and which is held in solution during the heat of the sun; but if it be not carried off by the wind, part of it, at least, falls down again after sun set, on being condensed by the cold. At the same time the earth continues to emit vapours during the night, on account of the heat communicated to it in the day time; this is undoubtedly condensed at the earth's sur-

face as it exudes. The greater portion of the dew found on moist land is thus formed by exhalations from the earth in the night, and a small part by the condensation of vapour already in the atmosphere, which, in still weather, will fall nearly equally. We never find much dew on dry roads, and pavements, except in foggy weather; but we frequently find heavy dews on fertile lands, and proportionally less on barren wastes. Not long ago, I inverted a large tub in a fertile field for several successive nights, and have always found dew under it the next morning, but not in such large quantities, as on the adjacent grass, where the condensed vapour had liberty to fall. I also inverted the same tub, for a few hours, during the heat of the day, and found dew under it even while the sun was up, which must have exuded from the ground as above described.

Qu. 10.

Mr. *Laidlaw*, *Brooklyn*. Although the body of a man, when alive, is, according to its bulk, specifically lighter than water, yet, at the time he is drowning, or very soon afterwards, he takes into his body such a large quantity of water as makes him heavier than the same bulk of water; of course he will sink. In a short time, which depends on the state of the weather, as to heat and cold, putrefaction takes place, a quantity of air is generated by the putrefactive process, which expels the water from the intestines; the whole mass of the body then becomes lighter than an equal bulk of water, and, according to the known principles of hydrostatics, it will rise and float near the surface.

C. K., *Albany*, sent us a solution to Qu. 7, concerning the balls; we shall just observe, at present, that different opinions are afloat, and the question must stand over for a few months, till the matter can be brought to issue.

NEW PHILOSOPHICAL QUESTIONS.

Qu. 11. *By Mr. Harrison.*

What motive, or intention, have brewers for boiling their wort, previous to fermentation?

Qu. 12. *By Zero.*

It is required to show, whether corollaries 2 and 3, to prop. 7. book 1. *Newton's Principia*, be *right*, or *wrong*; and, if wrong, to point out the error.

Qu. D. *By Zero.*

Determine the equation of the curve which is such that the rectangle of its length and abscissa, may always vary as the cube of the corresponding ordinate.

Qu. E. *By Zero.*

Required, the curve, in which the radius of curvature varies as the square of the corresponding length of the curve.

*** No solution to Qu. B. will be published before August next; if we do not receive a solution to it before that time, the proposer's solution will be given.

MATHEMATICAL CORRESPONDENCE.

MATHEMATICAL QUESTIONS IN NO. 2 ANSWERED.

Qu. 16. *Answered by Mr. J. Laidlaw.*

Let $x =$ number of miles the first party rode, then $7 : 3 :: x : 3x \div 7$ is the distance travelled by the pedestrians, while the coach travelled x miles, and $4x \div 7 =$ the miles the coach gained on them in the same time. At the end of x miles, the coach having to return for them behind; and as there is then $4x \div 7$ miles between them, it follows that $10 : 3 :: 4x \div 7 : 12x \div 70$, the distance moved by the pedestrians while the coach was returning. When the pedestrians and coach came together, it is evident that the pedestrians have travelled just as far as those before had to travel when the coach left them. Hence $3x \div 7 + 12x \div 70 = 9 - x$, whence $x = 5\frac{5}{8}$ miles, is the distance required. Mr. N. King proceeds thus:

From the nature of the question, both parties share equally in the riding and walking, but ride more than they walk. Let x be the distance walked by the pedestrians, and y the distance the coach had to return; $7x$ will measure the time on foot, and $6y + 3x$ the same in the coach. Beside that equation, we have $2x + y = 9$, whence $y = 2\frac{1}{4}$, and $x = 5\frac{5}{8}$ miles.

Qu. 17 *answered by Y. of New-Haven.*

1. If the vertex of the triangle be the middle point of one of the sides of the square, with this point as a centre, radius = the side of the square, intersect the adjoining sides of the square, join these points, and the point in the middle of the side, which will evidently form the triangle required. 2. When the angular point coincides with one of the angles of the square. Conceive a square ABCD, draw the diagonals AC, BD, and

with any assumed point G, in DC, take GH a fourth proportional to DC, AC, DG, and intersect DB in H. From B draw BE parallel to HG, and it will be one side of the triangle required. Because DG : GH :: DC : CA, by similar triangles DE : EB :: DC : CA. But DE : EF :: DC : CA ; therefore BE = EF = BF. 3. If the given vertex be neither at the middle of one side, nor at an angular point of the square ; let a be the side of the square, and b greater than $\frac{1}{2}a$, the distance of the vertex of the triangle from one angular point of the square. If x and y be the greater and less distance of the other two corners of the triangle from the adjacent corners of the square, we have the three following values, for the sides of the triangle $b^2 + y^2 = (a—b)^2 + x^2 = a^2 + (x—y^2)$; from which which $3\ y^4 + (26^2—4\ ab)\ y^2 = (2\ ab—b^2)^2$; an equation which, if necessary, may be geometrically constructed.

Qu. 18. *Answered by Mr. Strode E. Bradford, Chester County, Pennsylvania.*

Let a, b, be the distances from the stations to the perpendicular, m, n, the cotan. at these stations, x the alt. then $a = mx$, and $b = nx$, and $mx—nx = a—b$ ($= d$,) the difference between the stations ; whence, $x = d \div (m—n.)$ Q. E. D. The solutions by Mr. O'Connor, Mr. C. Davis, and Mr. G. R. Hazard, were very similar to the above. Y. adds the following *Scholium.* This theorem is true only for an inaccessible object on a plane ; for in the case of an object on an elevation, there are two stations at which the angles subtended by it will be equal ; whence the difference of the cotan. would be $= o$, and this theorem would give the altitude infinite. *Note.*—The solutions received mostly refer to stations taken on the same side of the object ; but the theorem is equally true when they are in the same right line on *different* sides of the object, only, in this latter case, we must take the sum of the cotan. instead of their difference.

Qu. 18. *Answered by Analyticus.*

It is obvious that the curve surface of the cone is developable on a plane, being the sector of a circle, of which the radius is the slant side of the cone, and the arc = the circumference of the base. Also, the eastern or western half of the conic surface, is the sector of a circle to the same radius, and having its arc = the circumference of the base. Now the two given points of commencement and termination of the road, are evidently at the extremities of the arc of the sector; and the least distance sought must be the straight line, which is the chord of the said arc; and the perpendicular let fall from the centre of the sector on the chord of the arc, is the nearest distance of the road, from the summit of the mountain. Also, if a series of radii be drawn in the sector, cutting the chord, the parts of these radii intercepted between the centre and chord, or between the circumference and chord, will be the respective distances of the road from the summit of the mountain, or from the circumference of its base, on the corresponding slant sides; and thus every part of the road is actually determined. Y., after his solution, adds: "Taken on the superfices of the cone, this curve is a line of double curvature. To express its equations by means of three co-ordinates, let x, y, z, be those co-ordinates, *viz.* z = perpendicular from any point on the base, y a perpendicular on the vertical section passing through the extremities of the curve, and x a perpendicular on the vertical plane which is at right angles to the one last mentioned. Also let the radius of the base, the perpendicular and the slant height, be respectively denoted by r, a, and b, and the circumference of a circle whose diameter is unity by p; then the equations of the curve will be $\frac{r^2}{a^2}(a-z)^2 = x^2 + y^2$, and $\sqrt{(x^2+y^2)}$. sec. $\left(\frac{r}{b} \times \frac{1}{2}p\right) = r.\ \text{sec.}\left(\frac{r}{b}.\ \text{arc (sin.} = \frac{x}{\sqrt{(x^2+y^2)}}\right)$ *Scholium*,

The same method furnishes us with the shortest distance between any two points on the cone, the cylinder, and the groin.

Qu. 19. *Answered by Mr. O. Shannessy.*

Let $x =$ the number; then the log. of any quantity is $=$ to its hyp. log. $\times$ by the modulus of the system, which in the common logs. is ,43429, &c. $=$ M; therefore by the qu. $x - M \times h.\ l.\ x =$ a min. its fluxion being put $= o$, gives $x = M$, the number required. Mr. Strode. Let x be the number, then $x - \log. x =$ a min. the differential of which is $dx - \frac{dx \times M}{x} = o$ ($M = ,434$, &c.) and $xdx - dx \times M = o$, whence $x - M = o$, or $x = M$. Zero. Let a be the base of *any* system of logs. and let $x =$ log. of the required number; then, $a^x - x$ must be a min. Therefore $\frac{dx\ a^x}{m} - dx = o$ whence $ax = m$. In the present case $m = ,434$, &c. $=$ the number required by the question. The solutions by Mathetes and Mr. O'Connor, were similar to this by Zero

Qu. 20. *answered by Mr. O. Reynolds, P. M. Baltimore.*

Put $a = 1$ foot, $b = 7\frac{1}{7}$, $x =$ the required thickness of the shell; then, $(a + 2x^3 - 1) \times b$, is proportioned to the weight of the shell, and $(a + 2x)^3$ is proportional to the weight of a globe of water of the same size. Now, by the principles of hydraulics, these expressions are equal; from whence, by reduction, $x = ,01163$ parts of a foot. Mr. O. Shannessy. The content of the cavity is, ,5236 of a foot $= c$, that of the sphere (diameter x) is cx^3, and as the weight of the body $=$ that of the fluid displaced, we have $(cx^3 - c) \times b = \frac{1}{2} cx^3$; whence, by reduction, &c. x is found $= ,011625$ of a foot. Mr. Strode. Put $p = ,5236$, $a = 1$ foot, $b = 7\frac{1}{2}$, $x =$ thickness of the shell; then, $\frac{1}{2}(a + 2x)^3 \times p = (a + 2x)^3 \times bp - a^3\ bp$, and by

reducing the equation x is found $=$,1392 inches ; and exactly in the same manner is the solution given by Mr. Laidlaw.

Qu. 21. *answered by X. Y. Z., Albany.*

Put the half sum $= 16 = a$, $8056 = b$ and half the difference of the numbers $= y$; then $a + y =$ greater, and $a - y$ $=$ less number ; also $2a^2 + 2y^2 =$ sum of their squares, and $2a^3 + 6ay^2 =$ sum of their cubes, therefore $2a^3 + 6ay^2 - 2a^2 - 2y^2 = b$; restoring the numbers we have by reduction, $y = 2$; and $a + y = 18$, and $a - 7 = 14$, are the numbers sought. The answers by Messrs. Strode, Laidlaw, and O'Shannessy, are exactly the same. Mr. Hazard. Let $x =$ one number then $32 - x$ is the other, then the difference between the sum of their squares and that of their cubes, gives $94\,x^2 - 3008\,x = -23688$; from which equation $x =$ 18 or 14, the numbers required. Mr. O'Connor. Put $x + y$ $= 32$, and $x^3 - x^2 - y^2 + x^3 = 8056$; then from the cube of the first equation take the second, and there remains $(3\,y + 1) \times x^2 \times (3\,x + 1) \times y^2 = 24712$. From the first equation $y = 32 - x$, and $y^2 = 1024 - 64\,x + x^2$. Substituting these values of y and y^2, in the preceding equation, we have $97\,x^2 - 3\,x^3 + 3\,x^3 - 191\,x^2 + 3008\,x + 1024 = 24712$. By transposition, &c. $x^2 - 32x = -252$. By comp. the square, &c. $x = 28$; therefore 18 and 14 are the numbers required.

Qu. 22. *answered by Analyticus.*

Let $t =$ co-tan. of the angle contained by the ordinate y, and curve z ; then, $dy, = tdx$, $dz^2 = dx^2\ (1 + t^2\ ;)$ and by substitution the given equation $ddy = dz^2$ becomes $dtdx = dx^2\ (1 + t^2\ ;)$ whence $dx = \dfrac{dt}{1 + t^2}$ and $dy = \dfrac{tdt}{1 + t^2}$, the integrals of which are $x =$ arc tan. t, and $y = h.\ l.\ \surd(1 + t^2,)$ and consequently y $= h.\ l.$ sec. x; the quantities x, y, t, being supposed to begin together The differential of the area $= ydx = dx\ h.\ l.$ sec.

x; but by *Em. Trig.* *h. l.* sec. $x = \frac{x^2}{2} + \frac{x^4}{12} + \frac{x^6}{45} + \frac{17x^8}{2520} +$ &c. which multiplied by dx, and the integral taken, we have the required area $= \frac{x^3}{2.3} + \frac{x}{5.12} + \frac{x^7}{7 \cdot 45} \frac{17\,x^9}{9.2520} +$ &c.

The total area contained by one branch of the curve, its assymptote, and base $\frac{p}{2} = \frac{3.1416}{2}$, may be exhibited by means of circular arcs and logarithms, being equal to $\frac{p}{2} \times h.\ l.\ 2.$

Y. of New-Haven, proceeds thus:

Since $d^2y = dx^2 + dy^2$, $\frac{d^2y}{dx^2} = \frac{dy^2}{dx^2} + 1$, or (making $\frac{dy}{dx} = q) = q^2 + 1$. But since $\frac{dy}{dx} = q$ and dx is constant, $\frac{d^2y}{dx^2} = \frac{dq}{dx}$; from which $dx = \frac{dq}{q^2 + 1}$, and $x =$ arc (tan. $=$ q.) Hence dy $(= qdx) = \frac{qdq}{q^2 + 1}$, and $y = h.\ l.\ \surd\,(q^2 + 1.)$ Since, therefore, $q =$ tan. x, and $\surd\,(q^2 + 1) =$ sec. x, the equation of the curve is $q = h.\ l.$ (sec. x,) which needs no correction, if the co-ordinates be supposed to commence together.

To find the area of this curve: if q be the tangent and s the secant of an arc equal to the absciss x, since $y = h.\ l.\ x$, ydx the differential of the area $= d\,(\times\, q) - x\,.d\,(h.\ l.\ s.)$ But, $ds = qsdx$, and $d\,(h.\ l.\ s.) = qdx$; so that $x\,.d\,(h.\ l.\ s.) = qxdx$. To obtain the integral of this expression in a series, let the common series for the tangent of an arc x be reversed, and each term multiplied into xdx. Subtracting the sum of the integrals of

these terms from that of $d\ (xy)$ we have the required area $= xy -$ $\left(\frac{x^3}{3} + \frac{1}{3} \cdot \frac{x^5}{5} \cdot \frac{2}{15} \cdot \frac{x^7}{7} - \frac{q7}{1576} \cdot \frac{x^9}{9}\right)$ This series converges the more rapidly the smaller x is, and the whole expression becomes infinite when $x = \frac{1}{2}\,p$.

Zero, after his solution, observes, that this curve may be constructed geometrically, by drawing a straight line, and taking from one end of it, distances always $=$ to B, or x; then erecting perps. $=$ to the logs. of the secants of all the arcs B, which correspond to the aforesaid distances, and then drawing a curve through the extremities of all the said perpendiculars; then will the area of this curve give the area required. Or, since x or B increase uniformly, the question is, to find the sum of the logs. of all the secants of the area B, increasing by infinitely small common differences. But when a differs from unity, we must, in the construction, take the logs. of the quotients arising from the division of the secants by a, and proceed as before.

Qu. 35. *By Mr. Laidlaw.*

Admit that gravity at the earth's surface were to be increased by one hundredth part—what would be the length of a pendulum vibrating seconds. Also, what would be the length of a pendulum vibrating three times in five seconds?

Qu. 35. *By Mr. N. King, Hamilton, M. C.*

Determine, geometrically, an arc, the cosine of which is equal to the tangent of half the arc.

Qu. 37. *By Y. of New-Haven.*

Having given the solid content of a paraboloid, to find when the inscribed sphere is a maximum?

Qu. 38. *By J. Garnett, Esq. N. Brunswick.*

A rectangular flood-gate is placed vertically, with its upper edge just even with the surface of the water, and turns on a horizontal axis, the part of the gate below which axis is *two* feet; what must be the whole length of the gate, so that the pressure against the parts above and below the axis, may be equal, or so that the gate may remain in equilibrio?

A number of letters, *postage unpaid*, were sent this month, directed to the Editor of the Scientific Journal—this is labour lost, as such letters will never be received. The Editor has removed to 76 Murray street.

The following is a list of the names of the gentlemen who answered the questions for No. 5.

Analyticus, New-York,	16.	17.	18.	18.	19.	20.	21.	22.	23.
Mr. R. G. Hazard, Bristol,	16.	17.	18.	18.	19.	20.	21.		
Mr. N. King, Hamilton, M. C.	16.	17.							
Mr. J. Laidlaw, Brooklyn,	16.				19.	20.			
Mr. Rt. Maar,	16.	17.	18.	18.	19.	20.	21.	22.	23.
Mathetes, . . .	16.	17.	18.	18.	19.	20.	21.		
Mr. M. O'Connor, N. York,	16.	17.	18.	18.	19.	20.	21.	22.	
Mr. O'Shannessy, Albany,	16.	17.	18.	18.	19.	20.	21.	22.	
Mr. O. Reynolds, Baltimore,	16.	17.	18.	18.	19.	20.	21.	22.	23.
Mr. Strode, E. Bradpord, Pa.	16.	17.	18.	18.	19.	20.	21.		
X. Y. Z.						20.			
Y. New-Haven,	16.	17.	18.	18.	19.	20.	21.	22.	23.
Zero,	16.	17.	18.	18.	19.	20.	21.	22.	23.

Mr. R. G. Hazard also sent a solution to *Qu.* A.